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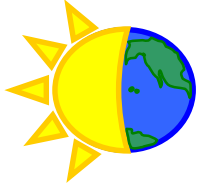
Product Quality and System Performance in the Kenyan Solar-Home-System Market

Stepping stones to a sustainable solar energy market

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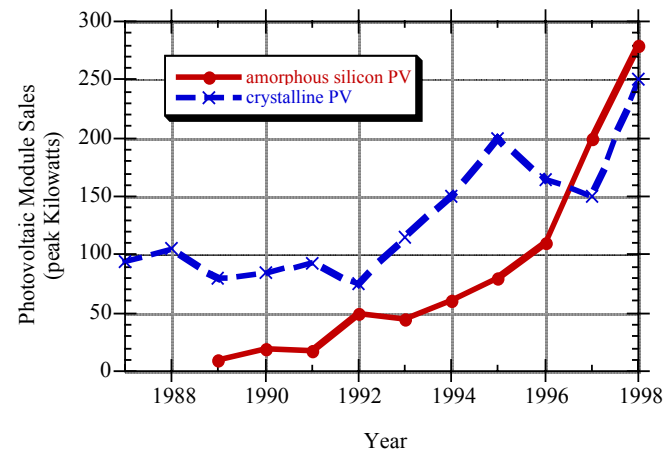
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The PV Market in Kenya: Large, Dynamic & Diverse

- Over 120,000 systems sold to date
- 20,000 new systems sold each year
- Market dominated by private sector (limited NGO and government roles)
- Highly competitive:
 - Over 20 major import and manufacturing companies
 - Hundreds of small shops in regional towns sell solar equip.
 - Over 1,000 “solar technicians” have installed PV systems for pay

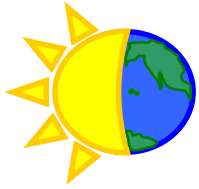


Sales of PV Modules in Kenya.



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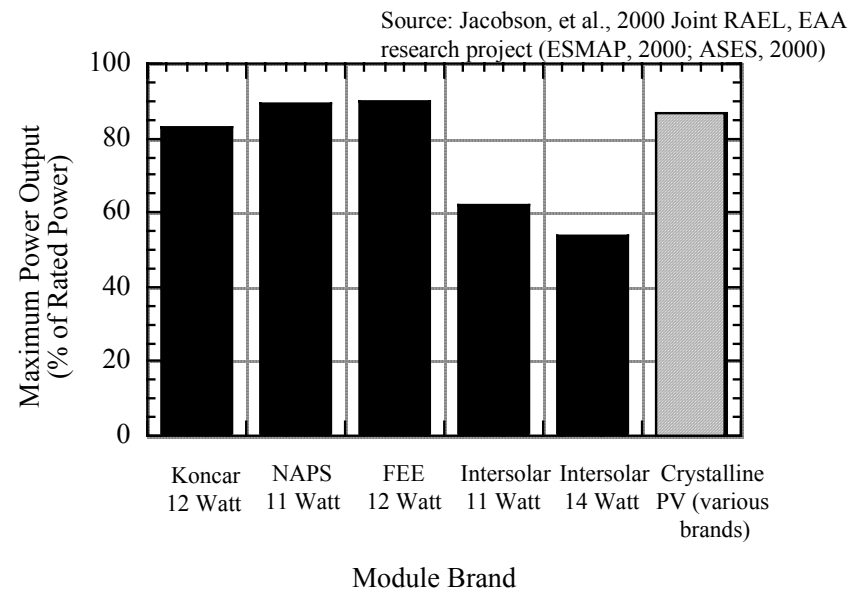
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Research Results: Product Quality Varies

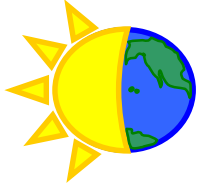
Research carried out in 1999 by a Berkeley-Princeton-EAA* Team indicates that in the solar-home-system market:

- Performance varied significantly among a-Si PV module brands.
- Many consumers do not differentiate between PV brands.
- High quality brands are not rewarded with price advantage.
- Similar problems evident with other SHS components like batteries, inverters, charge controllers.



Performance Comparison of
a-Si Module Brands

*Energy Alternatives Africa, Ltd. (EAA), of Nairobi, Kenya



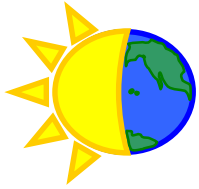
Research Results: Design & Installation Problems

Design problems:

- PV panels undersized relative to loads & batteries oversized relative to panels
- 70-90% of design decisions made by vendors and customers w/o technician input
 - Only 7% of shops that sell PV specialize in it (n=136 vendors)
 - Non-specialist vendors (e.g. Nizar Autospares, Ltd.) have little design knowledge
- Little design knowledge even among “solar” technicians
 - Only 17% able to correctly size a battery for a SHS (n=264 installers)

Installation problems:

- PV owners self-install 50% of small systems making substantial errors
- Trained technicians could do better for a price but benefit-cost ratio unclear

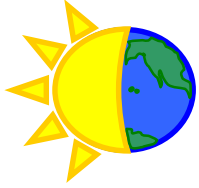


Research Results: PV System Owner Knowledge is Lacking

Interviews in 1999 with over 150 system owners suggest:

- Users shorten battery life through chronic excessive discharge
 - Vendors create unrealistic performance expectations
 - Vendors/technicians fail to teach system management
- Research, demonstration, and education outreach programs needed to improve end-user learning

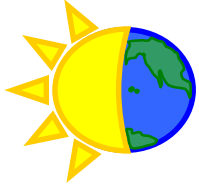




Research Results: Market Profile of Kitale

Kitale: 1 of 19 towns surveyed in 2000:

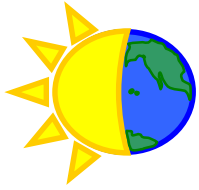
- 50,000 inhabitants in farming region of Western Kenya
- ~ 1,000 PV panels sold per year
- Customer choice is high
 - 7 PV brands, 8 battery brands, 15 shops, 57 installers
- Quality of PV services is limited
 - only 1 of 15 shops specializes in solar
 - only 1 of 22 installers interviewed trained in solar
 - 70% of PV system sales do not include installation services
- PV market dominated by private actors
 - no government regulatory presence
 - no NGO support for training or consumer advocacy



Suggestions for Improving Quality and Performance in the Kenyan PV Market (1)

Strategic and institutional considerations:

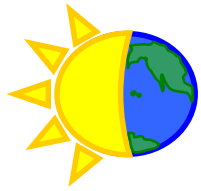
- Address system quality issues as first priority above developing new market expansion mechanisms
 - growth has averaged 20-30% annually in late 90s without major public interventions
 - reducing uncertainty about equipment quality will further boost unsubsidized sales through existing retail channels
 - new market expansion mechanisms may also promote quality, but the cost-effectiveness and sustainability of these approaches are unclear
- Private sector is important but other institutions are also essential
 - NGOs for consumer advocacy, information dissemination, and training
 - Government role for (limited) quality regulation



Suggestions for Improving Quality and Performance in the Kenyan PV Market (2)

Multilaterals should support industry-wide quality via government and NGO channels:

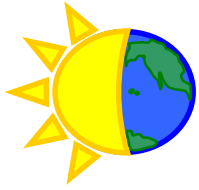
- Consumer advocacy and education
 - Consumer literature (in appropriate languages)
 - Informational radio and TV programs
- Technician & vendor education
 - Technician training
 - Simple local-language design manuals for vendors
- Quality assurance mechanisms
 - Testing with disclosure of results and/or voluntary certification
 - Quality standards
 - Business models that foster quality
(e.g. fee-for-service and credit programs requiring certified components)



Suggestions for Improving Quality and Performance in the Kenyan PV Market (3)

Develop research partnerships to identify and solve PV market problems:

- Research priorities:
 - Short-term BOS component testing under laboratory conditions
 - Long-term component and system performance testing under field conditions (ideally tracking from point of purchase)
 - Mechanisms for knowledge transfer to vendors, technicians and end-users
 - Role of non-market actors in sustained market growth
 - Structure of PV markets and place-specific factors affecting their development
 - Long-term potential of fee-for-service
- Strengthen capacity for applied SHS research and outreach : $N \Leftrightarrow S$, $S \Leftrightarrow S$
 - Fund collaborative projects between domestic and international research groups
 - Build local capacity
 - Ensure results flow to policy makers, vendors, technicians, and users



Recent Publications by RAEL on PV

See <http://socrates.berkeley.edu/~rael>

- Duke, R.D., and Kammen, D. M. (1999) "The Economics of Energy Market Transformation Initiatives," *The Energy Journal*, vol. 20 (4), 15-64.
- Jacobson, A., Duke, R., Kammen, D. M., and Hankins, M. (2000) "Field Performance Measurements of Amorphous Silicon Photovoltaic Modules in Kenya", Conference Proceedings, American Solar Energy Society (ASES), Madison, WI, June 16-21, 2000.
- Duke R., Graham S., Hankins M., Jacobson A., Kammen D., Osawa B., Pulver S., and Walther E., (2000) "*Field Performance Evaluations of Amorphous Silicon (a-Si) Photovoltaic Systems in Kenya: Methods and Measurements in Support of a Sustainable Commercial Solar Energy Industry*", ESMAP, World Bank Technical Report 2000-005.
- Jacobson, A., Duke, R., Kammen, D.M. (2000) "Amorphous Silicon PV Panels: Are they a good value for the money?", *Solarnet*, vol.2, No.2, Nairobi, Kenya.
- Duke, R., Jacobson, A., Kammen, D.M. (2000) "Product Quality in the Kenyan Solar Home Systems Market", in preparation for *Energy Policy*.